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SCIENCE

FRIDAY, SEPTEMBER 5, 1919

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RESEARCH AND APPLICATION¹

FOR nearly half a century, it has been the custom in this society to give its president every year "his day in court," and in conformity therewith many brilliant addresses have been delivered, and almost every conceivable subject has been discussed. It is therefore becoming more and more difficult for the incumbent to select a theme which shall have the merit of novelty, unless, perchance, he is himself working in the laboratory, and can bring forth some new and shining example of the progress of his science. I have not the good fortune to be so situated, and I must perforce satisfy myself with some other line of procedure in the hope that even in a discussion of old and well-known facts, some new light may be thrown, which will not be altogether without value. I have therefore selected for my subject, "Research and Application," knowing that many of my hearers have been spending their lives in considering and teaching it, and are far better prepared to instruct me than I am to reciprocate. I would remind such that there is at last a large and growing number of people who are intensely interested in what the chemist has done and is doing and still more in what he will accomplish in the future. It is therefore rather to that public, many representatives of which are present to-night, than to the chemists in this gathering that I would address myself.

Research in the distant past was the privilege of the few. In chemistry, during the middle ages, the alchemists were practically the only ones pursuing it, and they in secret, and not always from the highest of motives. Working by themselves, as they did, they had not the great advantage of meeting and discussing with others similarly engaged, and using their progress and mistakes to intensify

¹Address of the president of the American Chemical Society, Philadelphia, September 4, 1919.

their own increase in knowledge. Thus it has come about that the science of chemistry is little more than a century old, and its tremendous advances only a few decades. The first chemical society in the world was born in Philadelphia in 1793, and yet the real advances have been made since the formation of this society in 1876. Since that time, however, the advance in knowledge has been startling, not alone in this country, of course, but in all civilized countries. It is not boasting to say, however, that during all that time, the progress in this country has been in no wise behind that of the best anywhere, which our public is at last beginning to recognize. Particularly during the trying period of the war, when vast and new problems were suddenly thrust upon them, the work of our chemists has been beyond praise.

At the foundation of all this advance, research is firmly imbedded. Without it, the structure could not have risen, or the glowing anticipations of the future even imagined. Twenty centuries ago, we were told "Seek and ye shall find; knock and it shall be opened unto you." No one can deny that there have been accidental discoveries, some of great moment; but this has not been and will not be a safe dependence. Walking on the street one day, I picked up a roll of bills, whose owner curiously enough could not be found; but this did not lead me to give up my ordinary occupations, and wander around the streets of New York with the hope of further and continued good fortune of like character. Accidental discoveries are not to be relied on, of course, although they are not to be scorned. In chemistry the accidental good fortunes have usually come to those who were really seeking, although possibly for something far different, but, note this, they were usually made by men qualified to recognize an important discovery when it flashed across their vision.

Research, of course, is not of necessity to result in invention. It may in that respect terminate in a cul-de-sac from which with present knowledge there is no egress, or what more frequently happens, it may lead to a line of reasoning, which in time leads to another, and so on, until suddenly a bright light

illuminates the way, and a goal of the greatest possible importance is attained. Many instances illustrative of this will occur to you. I will cite only one, and that one because of the importance it has assumed in the light of recent developments.

As early as 1882 scientists rigidly established by chemical research what chemists call the "constitution" of the blue vegetable dye, indigo, and clinched that scientific conclusion by preparing the identical material in the laboratory. This particular important addition to human knowledge has remained a discovery merely; yet it so stimulated the search for practicable methods of applying that discovery to human needs that voluminous researches in a number of European countries were undertaken almost at once for that purpose. Of the host of scientific discoveries made as the direct result of chemical research in this direction, one was selected in 1897 as of such promise as to warrant the expectation that it would successfully displace vegetable indigo. Such was the ultimate fact. But, in 1901, others succeeded in devising a commercial mode of making indigo which was so formidable a rival to the mode adopted in 1897 that it seriously and at once threatened the supremacy of the latter, a thing which is now, some eighteen years later, actually coming to pass. It is worth while reflecting that the men who accomplished the scientific work of 1882 themselves never succeeded in making that work anything more than a discovery, despite the fact that for more than fifteen years they energetically tried to do so, and in their efforts they had the close cooperation of a large commercial organization. However, it remained for a college professor of chemistry in another country and himself working in quite a different field, and as a direct result of that work, to hit upon the central idea of the successful indigo mode of 1897 and to clinch it by appropriate laboratory methods. Yet his work remained for almost seven years a discovery only—a promising discovery to be sure—until the intensive work of others, overcoming many obstacles, made it serviceable to mankind. These two sets of workers were engaged in the same general class of chemical research, that

is, they were working in the organic division of chemistry. As you know, chemistry is serviceably, even though crudely, grouped under two grand divisions, organic and inorganic, and for many years these were treated quite separately from each other; I know "organic" chemists who look with mild indulgence upon the "inorganic" chemists and I also know inorganic chemists who return the compliment—with interest. In 1901, however, one of these so-called "inorganic" chemists, in searching for new worlds to conquer, hit upon an idea which he thought would make one of the discarded and discredited methods of making indigo a worthy rival of the only commercially successful indigo method of that day. And he was right! The owners of the 1897 method were forced to look to their laurels.

The history of the synthetic production of indigo is filled with many different discoveries of how indigo may be made in the laboratory, most of them wholly unrelated to the methods of 1882, 1897 and 1901. Two, at least, of them have made an unsuccessful and short-lived attempt to grow into an invention capable of meeting competitive conditions. Now, it is curious to note that the 1901 method was an offspring of the cyanide method of extracting gold which in turn is the gold-extraction method that made the South African gold fields so valuable. Immense amounts of that deadly poison, sodium cyanide, were needed in preparation for this gold extraction; that, in turn, called for unusually large amounts of other things and among these was that particular inorganic material that gave competitive ability in the world's markets to one of the theretofore discarded indigo methods. From the gold fields of South Africa to synthetic indigo is, indeed, a long cry. Is it, therefore, not wholly reasonable to expect that from some other equally far-off branch of chemical industry or of chemical research may come the proper stimulus to bring to active competitive life some of these other discarded indigo methods or even to create new methods superior to any we know of to-day? Among chemists we also distinguish physical chemists who are curious

about subjects in that great twilight zone between the field of chemistry on the one hand and of physics on the other; also we have the electrochemist who is always searching for more or less direct chemical applications of the electric current. Just as the inorganic chemist in 1901 taught the organic chemist the secret of endowing a discarded indigo method with competitive life, may we not reasonably expect that some day the physical chemist and the electrochemist may, one or both, in the course of wholly unrelated chemical research work, come across facts which when intelligently applied to the indigo problem may still further advance it?

The chemical knowledge and research that enter into the synthetic production of indigo, as we know it to-day, come from over three generations of chemists, scattered all over the globe, speaking many languages, researching on many different and separate problems which touch almost every phase of human endeavor, and the end is not yet.

For centuries indigo has been the undisputed king among dyes. Chemists have made many attempts to displace it by other dyes, but it has so far successfully withstood all such attacks upon it—except as to its source or origin. Indigo is still the king, but its supremacy is threatened and threatened seriously and its undoing, if that should ensue, is traceable directly to itself. Chemists have long felt sure that the true reason for the supremacy of indigo lay in the manner in which it dyes fabric. It possesses the unique faculty of being, what you have all so often read of in the daily papers, a "vat" dye. It is the pioneer vat-dye and until comparatively recently it was the only vat-dye. Vain attempts to create or imitate this vat-dyeing property in other dyes are recorded by the score in the history of coal tar dyes. But, about twenty years ago, a real vat-dye was constructed in a research laboratory which ultimately turned out to have an entirely different constitution from indigo. This supplied the key to an entirely new class of dyes. Although among the multitudes of "vat" dyes constructed along these new lines many are wholly worthless, there are, nevertheless, a

goodly number of them having all the desired advantages of indigo and others equally numerous, possessing highly prized advantages which indigo lacks. All of these good ones are free from certain disadvantages of indigo and, what is more important, their shades cover every tint in the rainbow satisfactorily except the reds and those can not much longer elude the searchers. Some day a new blue dye may result from these researches or from other researches growing out of them and indigo will no longer be king. In still other directions the chemical study of indigo has been fruitful. By proceeding along lines similar to those of the 1897 method, but displacing the nitrogen by sulfur, an entirely new line of materials has been made accessible through chemical research and no man is wise enough to place the limit upon the directions and the extent that chemical ingenuity and research will ultimately go in this one very small field of chemical effort, which requires and draws upon all the sources of chemical knowledge we have. The possibilities seem limitless.

True research must be intentional and intensive. We must really seek if we would find. We must really knock at the doors of the secret chambers of knowledge, if they are to be opened to us. We must have imagination, it is true, but we must have more than that. There must be the foundation of sound education, and the ability to extend it to embrace new and unexpected knowledge, and apply this in turn as we progress upwards.

To fit a man for research in chemistry or any other science, many things must be accomplished before the candidate is ready to take his first advanced step. Many methods of procedure have been suggested, and some heat of argument generated; but all agree that education which produces real practical knowledge is absolutely essential. All agree, also, that the person to be prepared must be a likely subject; and that energy and time should not be wasted on those who do not show that they possess certain necessary qualifications. I think that it will also be generally admitted that the teacher himself should not only have great attainments, but must also possess the rare

quality of being able to transmit knowledge in such a way that it will be truly absorbed by the pupil and form part of him. One of the greatest mathematicians I have ever known was about the poorest teacher. He knew but could not impart. The future of the world, therefore, depends in a very large degree, on the teacher in the school and on the professor in the college. They have an opportunity to mold the world, which many of them thoroughly appreciate. Alas, in most instances, the consciousness of work well done is about their only reward. Some day, and I hope not a very distant one, it will be generally recognized that, like other laborers, they are worthy of their hire, and their compensation will more nearly approximate the value of the work done. When that happy day arrives, they may experience a little less of the satisfaction of sacrifice, but they will have other comforts and hopes which will more than make this up to them and to their families. Like others before me, I advise the people of this country that they can make no better investment than one liberal enough to cause the teaching profession to attract not only those whose high sense of duty leads them to embrace it at a sacrifice, but also those who can not afford to make the sacrifice, however anxious they may be to do so. Men preparing for research must have the best men in the country to guide them, and it is not fair to expect these men, as so many have done in the past, to live the narrowing life of poverty. Neither is it wise.

There are a few foundations specifically provided for chemical research, such as the Warren Fund of the American Academy of Arts and Sciences, the C. M. Warren Fund of Harvard University, and the Wolcott Gibbs Fund of the National Academy of Sciences. There are a number of foundations for promoting research generally which have included chemical research within their fields, such as the Bache Fund of the National Academy of Sciences and the Elizabeth Thompson Science Fund. The Rockefeller Institute for Medical Research fosters chemical research contributory to its main object, the Carnegie Institution of Washington supports

chemical research in its general policy of advancing knowledge through research. The newest of all is the fund recently placed at the disposal of the National Research Council for stimulating chemical research. There is need for many more foundations if we are to keep pace with the rapid strides of civilization, or better still, to determine the direction they will take.

The importance of research is being more and more recognized and understood by the public. One of the most encouraging evidences of this is shown in the preamble and resolution adopted recently by the American Federation of Labor at Atlantic City, indicating, as these do, a clear appreciation by that great association of how much we all depend on what science will disclose to ameliorate the conditions of the future. It is well worth while to read these in full here. They are as follows:

WHEREAS, scientific research and the technical application of results of research form a fundamental basis upon which the development of our industries, manufacturing, agriculture, mining and others must rest; and

WHEREAS, the productivity of industry is greatly increased by the technical application of the results of scientific research in physics, chemistry, biology and geology, in engineering and agriculture, and in the related sciences; and the health and well-being not only of the workers but of the whole population as well, are dependent upon advances in medicine and sanitation; so that the value of scientific advancement to the welfare of the nation is many times greater than the cost of the necessary research; and

WHEREAS, the increased productivity of industry resulting from scientific research is a most potent factor in the ever-increasing struggle of the workers to raise their standards of living, and the importance of this factor must steadily increase since there is a limit beyond which the average standard of living of the whole population can not progress by the usual methods of readjustment, which limit can only be raised by research and the utilization of the results of research in industry; and

WHEREAS, there are numerous important and pressing problems of administration and regulation now faced by federal, state and local gov-

ernments, the wise solution of which depends upon scientific and technical research; and

WHEREAS, the war has brought home to all the nations engaged in the overwhelming importance of science and technology to national welfare, whether in war or in peace, and not only is private initiative attempting to organize far-reaching research in these fields on a national scale, but in several countries governmental participation and support of such undertaking are already active; therefore be it

Resolved, by the American Federation of Labor in convention assembled, that a broad program of scientific and technical research is of major importance to the national welfare and should be fostered in every way by the federal government, and that the activities of the government itself in such research should be adequately and generously supported in order that the work may be greatly strengthened and extended; and the secretary of the federation is instructed to transmit copies of this resolution to the President of the United States, to the president pro tempore of the Senate, and to the Speaker of the House of Representatives.

I hope and believe that this matter coming as it does from a new direction will be most seriously considered by the proper authorities—not that it has not already been well understood in Washington, but that renewed interest may be taken and even more liberal appropriations granted. The federation resolution urges that “a broad program of scientific and technical research is of major importance to the national welfare.” Good! Now that everybody is agreed, how was it possible that for so long a time this belief was held by so few, and these composed almost entirely of men of science? The question, therefore, is squarely before the country, and the urgency of it thoroughly appreciated by those who have the most to gain by it; namely, the workers on whose efficiency so much depends. Now this opens the way to a scientific solution of vital questions about which there has been such fundamental differences of opinion, based largely on what may be called the point of view. People have divided themselves into classes—a very dangerous course—and many—a very great many—have actually believed that there must of necessity be a deeply rooted

difference between capital and labor, and that the true interests of either were entirely apart from those of the other. Many have held that labor is a commodity which it was to their best interest to get the most of for the least money, while many others believed that labor was the sole source of all wealth, and that the fewer hours worked, and the smaller the output of those hours, the better it would be, somehow or another, for the laboring classes. I have cited the extreme views for purpose of illustration, realizing the somewhere between the two would be found the great body of all reasonable and thoughtful men. We may leave out of consideration here that ultra-extreme class who teach, whether they believe it or not, that the true interests of labor would be best served by sabotage and syndicalism, and all the other fantastic notions which have of late years been more or less in evidence, and liable to catch the unwary. To these, research presents no attractions.

Now I am going to venture to suggest to the working man who is earnestly desirous of bettering his own and his family's condition, that there are a good many sciences besides chemistry and the engineering and abstract sciences in general. Some of these he is better able to study and practise than any one else. Many of the fundamental truths concerning labor and its conditions would never be discovered by the scientist *per se*, because he has not had the benefit of practical preparation. Let our friends of the American Federation of Labor not be content with what the government can do in the line of their resolution, good as it has been and will be, but let them start a carefully planned series of researches themselves, and follow them up until the truth stands revealed. They can depend upon the assistance of this great society. The employers of labor have been doing this for years, singly and in groups, seeking the same end. The shining goal of all research is the truth, the whole truth, and nothing but the truth. Thus, starting from different angles, with fairness and thoroughness, the various so-called interests will arrive at the same truth, for there can only be one truth concerning any question. Thus will it come to pass that cap-

ital and labor will discover that the true interest of one is the true interest of all, and instead of bickerings and suspicions we will have that cordial cooperation which is absolutely essential if we could get the best out of this good old world of ours.

Scientific discovery is really not a haphazard matter. The art of making it can be cultivated, and definite rules of research can be laid down. Many elements enter into the problem and these have been very well tabulated by the late Dr. Gore, F.R.S., in his book, "The Art of Scientific Discovery." While the list he gives may not be complete, it is so nearly so that it is well worth quoting here. His table is as follows:

1. Aid to analogy.
2. Hypotheses.
3. Analysis and synthesis.
4. Application of (a) electricity to bodies; (b) heat to substances.
5. Asking questions and testing such questions.
6. Assumptions that—
 - (a) There is certainty of all the great principles of science.
 - (b) Complete homologous series exist.
 - (c) Converse principles of action exist.
 - (d) Certain general statements which are true of one force or substance are true to some extent of others.
7. Combined action of many observers.
8. Comparison of—
 - (a) Facts, and collecting similar ones.
 - (b) Collections of facts with each other.
 - (c) Facts with hypotheses.
 - (c) The orders of collections of facts.
 - (d) Facts with hypotheses.
9. Deducting process.
10. Employment of new or improved means of observation.
11. Examination of—
 - (a) Common but neglected substances.
 - (b) Effects of forces on substances.
 - (c) Effects of contact on substances.
 - (d) Effects of extreme degrees of force.
 - (e) Extreme or conspicuous instances.
 - (f) Influence of time upon phenomena.
 - (g) Neglected truths and hypotheses.
 - (h) Peculiar minerals.
 - (i) Unexpected truths.
 - (j) Rare substances.
 - (k) Residue phenomena.

- (l) Residues of manufacture.
- (m) The ashes of rare plants and animals.
- 12. Extension of—
 - (a) The researches of others.
 - (b) The researches of neglected parts of science.
- 13. Inductive process.
- 14. Investigations of—
 - (a) Exceptional cases.
 - (b) Unexplained phenomena.
 - (c) Classification unexplained.
- 15. Means of—
 - (a) Converse experiments.
 - (b) Hypotheses.
 - (c) Homologous series.
 - (d) Instruments of great power.
 - (e) Improved methods of intellectual operation.
 - (f) Measurements.
 - (g) The method of curves.
 - (h) The method of least squares.
 - (i) The method of means.
 - (j) The method of residues.
 - (k) New instruments.
 - (l) Modes of observation.
 - (m) Observations.
 - (n) More intelligent and acute observation.
 - (o) Additional observations by known methods.
 - (p) Periodic functions.
 - (q) More refined methods of working.
 - (r) Repetition of experiments.
- 16. Simple comparisons of facts of phenomena.
- 17. Search for—
 - (a) So-called "impossible" things.
 - (b) One thing and finding another.
- 18. Subjecting series of forces or substances to new conditions.
- 19. Use of—
 - (a) Known instruments or forces in a new way.
 - (b) Improved instruments.
 - (c) More powerful instruments.
 - (d) Causes by the methods of averages.
 - (e) Coincidences.
- 20. Conditions of—
 - (a) Scientific discovery.
 - (b) Determination of the nature of a discovery contrasted with barren reasoning.
- 21. Dependence of discovery upon art of exceptional instances.
- 22. Fundamental laws of discovery.

Research does not always lead to discovery, nor discovery to invention, but the sequence is logical. Gore defines the difference between discovery and invention in these words: "Discovery consists in finding new truths of nature, whilst invention consists in applying those truths to some desired purpose;" and that definition is sufficiently accurate. The natural application of research is therefore invention. How can this application and its corollaries best be carried out?

The concrete application of a truth is of course necessary for its widest usefulness. There are various theories as to the best way of accomplishing this. Take our old friend Wackford Squeers for instance—a highly interesting character in one of Dickens's best books:

This is the first class in English spelling and philosophy, Nickleby. Now then, where's the first boy?

Please, sir, he's cleaning the back parlour window, said the temporary head of the philosophical class.

So he is, to be sure, rejoined Squeers. We go upon the practical mode of teaching, Nickleby; the regular educational system. C-l-e-a-n, clean; verb, active, to make bright, to scour. W-i-n, win, d-e-r, der, winder, a casement. When the boy knows this out of a book, he goes and does it. It's just the same principle as the rule of globes. Where's the second boy?

Please, sir, he's weeding the garden, replied a small voice.

To be sure, said Squeers, by no means disconcerted. So he is. B-o-t, bot, t-i-n, tin, bottin, n-e-y, ney, bottiney; noun, substantive; when he has learned that bottiney means a knowledge of plants, he goes and knows 'em. That's our system, Nickleby; what do you think of it?

During the intense pressure of recent years, this Squeers system has had a good trial, and seems to have left more or less to be desired. The taxpayer knows the sequel, and will be reminded of it from time to time for the rest of his life.

The application of research has always required a high order of talent. In the future, a still higher order of talent will be necessary, but in addition this talent must be prepared

by education to do this very thing. Sir Robert Hadfield, F.R.S., has said, after England had been struggling with belated preparation for nearly two years:

Until quite recently many mistakes were made, either because the scientific man had been installed in view of his special knowledge, or, at the other end of the scale, the practical man was given the preference. In a general way neither of these types has been a success.

Admitting Sir Robert's conclusion, how can we produce the leaders who shall adequately combine both qualifications? That is one of the greatest and most interesting problems awaiting solution by our educators, and on its correct solution depends in a larger degree than many imagine, the future of successful and contented industry in this country. I shall not attempt in the presence of so many educators of acknowledged ability, to show the way, even if I felt persuaded that I knew it, as the matter is of too great consequence to run the risk of an amateur indicating the wrong road. I shall content myself by pointing out the need, with the hope of turning the attention of the great public to its existence. In our free country, the people generally get what they really want, and it is worth while to lead them to want the greater things, and not to be satisfied with the lesser.

There are certain fundamentals, however, that all will agree to, if it be true that the leaders of the future will have far greater problems to solve than have yet been conceived.

1. The candidate for leadership should have a healthy body. Great things have been accomplished by men and women of fragile physique, but they would have accomplished greater if they had not been thus handicapped.

2. He should have good habits, which involves good character. This is vital if we would have leaders who would be a blessing and not a curse. We can easily call to mind men of splendid health and intellect who used these gifts to the injury of their fellows, and not to their advantage. Do not waste time or energy in educating for leadership a man of bad or doubtful character or whose aims are selfish.

3. Of course he should have a good mind, educated to the highest degree attainable. This education should be specialized in the desired direction, while good all around. No really great leader can be lop-sided if he would avoid being a "crank."

4. He should have a thorough knowledge of human nature. To play on the "harp of a thousand strings" requires on unusual acquaintance with the instrument. How many men otherwise great have broken down here, sometimes because they have given too much confidence, sometimes not enough, sometimes because they did not know how to select assistants. The knowledge of human nature is a great gift in itself, which can be acquired and increased. It lies at the foundation of wisdom, which King Solomon pronounced the "principal thing."

With the qualifications enumerated and others which will occur to you, the candidate for leadership is well equipped. To direct him to full fruition is a noble task. Let us proceed to fill our high places of every kind with the men and women specifically prepared to fill them, being assured that the effort to do so will produce an army of those not quite qualified for the top, but of the greatest value to assist those who are, and who without such aid would resemble "faith without works," we are told, is "dead being alone."

Research leads to discovery, discovery to invention, invention—no one knows where. Applied and supervised by those prepared for the task, the strides of progress will be long, and the benefit to the human race in proportion. Let us educate for living—certainly—but let us also educate for leadership—that superlative leadership of which civilization will stand more and more in need, as it increases in complexity, and reaches higher and higher planes.

WM. H. NICHOLS

THE INTERALLIED CHEMICAL CONFERENCE¹

THE delegates of the Federated Chemical Societies of America, Belgium, England, France and Italy met in London, July 14 to

¹ Based on advance sheets from *Journal of Industrial and Engineering Chemistry*.

17, 1919. The United States was represented as follows: Dr. F. G. Cottrell, chief metallurgist, U. S. Bureau of Mines; Dr. C. L. Parsons, chief chemist, U. S. Bureau of Mines, secretary of the American Chemical Society; Dr. E. W. Washburn, professor of ceramic chemistry at the University of Illinois, past chairman of the division of chemistry and chemical technology of the National Research Council.

The proceedings of the conference were conducted in French, M. Moureu acting as chairman and M. Gérard as secretary. Almost the whole time was taken up in framing the constitution of the new body, which is to be known as the "International Union of Pure and Applied Chemistry," and in discussing the desirability of its inclusion in the scheme of organization projected by the Conference on Scientific Academies. The following officers were elected for a term of three years: *President*, M. Moureu; *Vice-presidents*, M. Chavanne (Belgium), Signor L. Parodi Defino, Dr. C. L. Parsons and Sir William Pope; *General Secretary*, M. Jean Gérard, 49 rue des Mathurins, Paris.

In addition to the five countries represented at this meeting, it was agreed that the British Dominions and the nations signatory to the Peace Treaty should each have separate representatives on making application. In this connection Canada and Poland have already signified their adhesion. It was also decided to admit neutral countries. With the exception of Belgium, each of the nations at present represented in the International Chemical Union has formed a national organization similar to the British Federal Council for Pure and Applied Chemistry; thus the United States has instituted a Chemical Division of the National Research Council; France, the Fédération Nationale des Associations de Chimie Pure et Appliquée; Italy, the Associazione Italiana di Chimica Generale ed Applicata.

The following resolutions were passed:

The International Union of Pure and Applied Chemistry, meeting in conference in London from July 14 to 18, 1919, hereby records the following opinions:

1. That the Confederation should be included in the scheme of organization contemplated by the Conference of Scientific Academies, with autonomous powers, as the Chemical Section of the International Research Council.

2. That it shall constitute "The International Committee of Chemistry."

3. That the various international delegates representing chemistry at the meeting of the International Research Council shall be appointed by the same National Federation which appoints the delegates to the Confederation.

4. That the officers of the present Confederation be, *ex officio* officers of the Chemical Section of the International Research Council.

It was decided to hold the next meeting of the International Chemical Union in Italy during the first two weeks of June, 1920.

The conference adjourned to meet again in Brussels on July 22 in connection with the International Research Council. The American delegates were joined by Dr. H. S. Washington. Professor Albin Haller joined the French delegation and presided over the meeting.

The meeting at Brussels was largely engaged in the discussion, modification and final adoption of the statutes of the new International Union of Pure and Applied Chemistry. It was informally agreed that the only apparent basis for international cooperation on the abstracting of chemical literature was a simple exchange of proof sheets of abstracts between the various countries interested, although it was thought possible that the Latin countries might be able to combine to advantage in publishing an abstract journal in French. Also it was informally agreed that America should go ahead with her proposed program on Scientific and Technical Monographs, the issuance of these to be later correlated, if possible, with the English program on Compendia of Organic and Inorganic Chemistry should their plans at first proposed be extensively modified.

The election of officers as made in London was confirmed and the International Union of Pure and Applied Chemistry became officially the chemical section of the International Research Council.

THE BRUSSELS MEETING OF THE INTERNATIONAL RESEARCH COUNCIL

A FEDERATION of National Research Councils met in Brussels on July 18-28. From an article in *Nature* we learn that the following countries and dominions were represented by their delegates: Belgium, Canada, France, Italy, Japan, New Zealand, Poland, Roumania, Serbia, the United Kingdom and the United States of America.

On the morning of July 18, the delegates met in the Palais des Académies, where King Albert was present. M. Harmignie, the minister of science and arts, welcomed them in a short address in which he dwelt on the importance of the occasion and on the valuable results which would be obtained from international cooperation in science, and wished them success in their deliberations.

M. E. Picard, the president of the executive committee, was prevented by ill health from being present, M. A. Lacroix presided at the meetings of the general assembly. The first business was the consideration of the statutes of the International Research Council which had been provisionally agreed upon in Paris, and now came up for consideration in the final form as recommended by the executive committee.

The objects of the council are therein defined to be:

(a) To coordinate international efforts in the different branches of science and its applications.

(b) To initiate the formation of international associations or unions deemed to be useful to the progress of science.

(c) To direct international scientific action in subjects which do not fall within the province of any existing association.

(d) To enter, through the proper channels, into relations with the governments of the countries adhering to the council to recommend the study of questions falling within the competence of the council.

The countries adhering to the council are those already mentioned as represented by their delegates as well as Brazil, Australia,

South Africa, Greece and Portugal—that is, those of the allied nations who were originally invited to form the International Council as possessing academies of science, and being engaged in scientific work. To these, other nations may be added at their own request or on the proposal of a country already belonging to the council, or union, by a three-fourths vote in favor of admission.

The work of the council will be directed by the general assembly, which will meet ordinarily every three years, but in the interval between its successive meetings business will be transacted by an executive committee of five members nominated by the general assembly and holding office until the next meeting of the general assembly. In the present case the executive committee, consisting of Professor E. Picard, Dr. A. Schuster, Dr. G. E. Hale, M. Volterra and M. Lecoqte, has been reelected and will consider its character and constitution and report to the next meeting of the general assembly before its organization is finally laid down.

The concluding meeting of the council was held on July 28, when it was decided that all neutral nations should be invited to join the International Research Council and the International Unions created under its auspices, thus providing for the reconstitution of international scientific associations so far as is practicable at the present time.

SCIENTIFIC EVENTS

THE GALTON LABORATORY

IN a letter to the London *Times* Professor Karl Pearson calls attention to the fact that in 1908 Sir Francis Galton died and left the residue of his estate to the University of London for the maintenance of a laboratory for the study of eugenics. The objects of that laboratory were to be: (1) Research concerning all that tends mentally or physically to the improvement of the race; (2) dissemination of the knowledge thus acquired by public lectures and publications; and (3) the accumulation of material bearing on problems of racial fitness. Owing to the generosity of Sir Herbert Bartlett, a building for the housing

of the Drapers' Biometric Laboratory and the Galton Eugenics Laboratory was completed in 1914. This building contains a public lecture theater, a public museum and library, archive and instrument rooms, anthropometric laboratories and investigation rooms, besides full provision for laboratory and class teaching, with private rooms for research workers. The building was used for war purposes and money is now needed to complete its equipment. Professor Pearson writes:

The Biometric and the Galton Laboratories were the first of their kind to be established; they no longer stand alone. The United States have their professors of biometry and their eugenics laboratories backed by funds which we can not hope to rival. Why is it that Britain so often starts the new idea, but leaves it to fructify in other lands? Especially important is at the present moment the field of activity for our science. The war has brought many problems to the fore; eugenical research has much ground to make up, and most serious questions as to national efficiency are demanding scientific treatment. The Galton Laboratory is in every respect in a worse position in 1919 than it was in 1914; its staff has to undertake far heavier and more urgent work than it then dreamt of; its buildings can not be properly equipped; its publication funds, slender in 1914, can not now encompass a third of what was possible at that date, for the price of printing, binding and publication is now nearly threefold; memoirs awaiting publication, can not be issued. And, lastly, the highly-trained staff, largely absorbed into national work during the past five years, can not be reestablished on the old basis, for the old scale of payment has ceased to provide a living wage. The war has in many cases crippled institutions as well as men. Are we to see the scheme of one of the most suggestive and inspiring men of modern times and a science wholly British in its inception reduced to fruition because the university and the Galton Laboratory staff did what lay in their power to aid the national cause in a time of grave pressure?

THE POTATO DISEASE CONFERENCE

ON June twenty-fifth to twenty-eighth the advisory board of American Plant Pathologists held a Potato Disease Conference on Long Island at which nearly one hundred persons chiefly interested in plant disease at-

tended. Meetings were held at Riverhead and Watermill, Long Island and at the Hotel McAlpin, New York City.

Three automobile excursions were taken through the island. On Wednesday, June 25, a tour was made of the north side where several most interesting field experiments were inspected. These experiments were conducted under the direction of representatives from the New York State College of Agriculture, the Suffolk County Farm Bureau, The Bureau of Plant Industry, United States Department of Agriculture, representatives from Canada and Bermuda, and the Geneva Agricultural Experiment Station.

On Thursday a trip was taken to the south side, where further experiments were inspected. During the afternoon, a meeting was held at Watermill, where addresses were made by Dr. A. D. Cotton, of the Board of Agriculture, England, who spoke on the development of plant pathology in England; by Dr. George H. Pethybridge, of the Board of Agriculture, Ireland, who gave a history of the phytopathological work in Ireland; by Dr. H. M. Quanjier, of the Pathological Laboratories, Wageningen, Holland, who gave a résumé of his researches on leaf-roll and mosaic of potato; and by Dr. H. A. Edson, of the Office of Cotton, Truck and Forage Crops Disease Investigations, Bureau of Plant Industry, who read a paper by Schultz, Folsom, Hildebrandt and Hawkins on "The Mosaic Disease of the Irish Potato."

On Friday, a tour of Nassau county was enjoyed by those attending the conference. Among the places of especial interest visited on this trip were the field laboratory of the New York State College of Agriculture, at Greenlawn, the Pratt Estate, at Glen Cove and Sagamore Hill, the home of the late Colonel Roosevelt. A special visit was also made to Colonel Roosevelt's grave.

On Saturday, about forty met at the Brooklyn Botanic Garden for a conference of the North East Pathologists on general plant diseases. At this meeting they were addressed by Dr. H. M. Quanjier, who gave an illustrated

lecture on potato leaf-roll. A short discussion was held upon some apple and tomato diseases.

The arrangements for this conference were in the hands of a committee under the chairmanship of Dr. M. F. Barrus, of Cornell University. The other members of the committee were: Messrs. H. H. Whetzel, of Cornell University; P. A. Murphy of Canada; E. J. Wortley, of Bermuda; W. A. Orton, of the Bureau of Plant Industry, and C. R. Orton, of the Pennsylvania State College.

MR. CARNEGIE'S WILL

THE will of the late Andrew Carnegie was filed on August 28. A statement issued by Elihu Root, Jr., says:

Mr. Carnegie's gifts to charity during his lifetime totalled somewhat in excess of \$350,000,000. The value of his estate is estimated at between \$25,000,000 and \$30,000,000. He really did divest himself of his great fortune for the benefit of mankind, as he long ago said that he would.

The will leaves the real estate and all the works of art and household goods to Mrs. Carnegie. Financial provision for Mrs. Carnegie and for Mrs. Carnegie's daughter, Mrs. Miller, was made during Mr. Carnegie's lifetime rather than by will.

The fourth article of the will contains a series of legacies, the most substantial of which are to charitable institutions. The fifth article of the will contains a series of annuities to relatives and friends. The Carnegie Corporation of New York is the residuary legatee, and Home Trust Company of New Jersey is the executor and trustee under the will.

The public bequests include: To the Cooper Union, \$60,000; to the University of Pittsburgh, \$200,000; to Hampton Institute, \$300,000, and to Stevens Institute, \$100,000.

The annuities include \$10,000 to Dr. Henry S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching and \$5,000 to Dr. Robert S. Woodward, president of the Carnegie Institution of Washington, and Dr. W. J. Holland, director of the Carnegie Museum at Pittsburgh.

SCIENTIFIC NOTES AND NEWS

MAJOR LAWRENCE MARTIN, General Staff, U. S. Army, who is chief, Geographical Section, Military Intelligence, U. S. Army, left Paris on August 17 for Turkish Armenia, Russian Transcaucasia and Persia, as geographer to General Harbord's Mission to Armenia.

WITH the approval of President Wilson, Dr. Charles H. Herty has sailed for France to obtain for dye consumers of this country a six months' supply of such dyes as are now needed but have not yet been manufactured here. The dyes include the so-called "vat colors," which are used chiefly by the manufacturers of wash goods. It is expected they will be shipped to this country within sixty days.

MAJOR F. E. BREITHUT, formerly of the Chemical Warfare Service Division of the United States Army, also assistant professor of chemistry at the College of the City of New York, has resigned to accept a position with The Foundation Oven Corporation.

MR. FREDERICK L. HOFFMAN, vice-president and statistician of the Prudential Insurance Company, has gone to England to make an intensive investigation into the effects of war on insurance, including the methods and results of national health insurance in Great Britain.

DR. ROLLIN T. CHAMBERLIN and Mr. Ben Herzberg are spending the summer in Alaska and northwestern Canada. The working season down to the early part of August was spent in special lines of investigation on particular phases of the mechanics of glacier movement in western Alaska and the remainder of the season down to the middle of September will be given to field work on the evidences of diastrophism in the northern Rockies.

PROFESSOR W. B. HERMS, associate professor of parasitology in the University of California, and a party of assistants, have completed a malaria-mosquito survey of California during the past summer and the former has resumed his university work. The survey was

begun early in 1916 and carried through the summer of 1917, but, owing to Professor Herms's absence while serving with the United States Army, the work was held in abeyance until the opening of this year. The greater part of the summer's work was carried on in the San Joaquin Valley, however, several weeks were spent in the mountainous countries of Alpine, Mono and Inyo and in portions of San Bernardino. The highest elevation reached was approximately ten thousand feet and the highest elevation at which Anopheline mosquitoes (*Anopheles quadrimaculatus*) were encountered at any time during the survey was 5,482 feet. A total of 18,088 miles were covered in the survey, all by automobile. A report of the survey in the northern third of the state has already been published (U. S. Public Health Report, July 18, 1919) and other reports will be issued in due time. The survey was conducted under the joint auspices of the California State Board of Health and the University of California.

DR. STUART WELLER, professor of paleontologic geology at the University of Chicago, succeeds the late Samuel Wendell Williston as director of the Walker Museum.

DURING summer quarter at the Yerkes Observatory of the University of Chicago, Paul Beifold, professor of astronomy and director of Swasey Observatory, Denison University, acted as voluntary assistant; Francis P. Leavenworth, professor of astronomy and director of the observatory at the University of Minnesota, as visiting professor, and Clifford C. Crump, professor of astronomy and director of the Perkins Observatory, at Ohio Wesleyan University, as volunteer research assistant.

MR. JULIAN S. HUXLEY, a scholar of Balliol College, Oxford, from 1905 to 1909, and from 1913 to 1916 associate professor of biology in the Rice Institute, Houston, Texas, has been elected a fellow of New College.

UNIVERSITY AND EDUCATIONAL NEWS

THE board of trustees of the University of Tennessee is planning to erect a building for

the medical department of the university at Memphis, to cost \$100,000.

At the University of Arkansas Dr. John T. Buchholz, formerly of the West Texas Normal College, has been appointed head of the department of botany, and G. P. Stocker, formerly professor of civil engineering in the Agricultural and Mechanical College of Mississippi, head of the department of civil engineering.

B. L. RICHARDS, Ph.D. (Wisconsin), has been appointed associate professor of botany at the Utah Agricultural College and Experiment Station.

MR. W. H. TIMBIE, author of books on electrical engineering and applied electricity, has been appointed associate professor of electrical engineering in the Massachusetts Institute of Technology.

DR. ALPHONSE RAYMOND DOCHEZ, of the Rockefeller Institute for Medical Research, has been appointed associate professor of medicine at the Johns Hopkins University.

PROFESSOR ANDREW HUNTER has been appointed to the chair of biochemistry in the University of Toronto, vacant through the resignation of Professor Brailsford Robertson.

DR. S. CHAPMAN, chief assistant at Greenwich Observatory, has been appointed professor of mathematics in the University of Manchester.

DISCUSSION AND CORRESPONDENCE

DIRECT PHOTOGRAPHY OF COLONIES OF BACTERIA

IN view of the desirability at times of obtaining photographic record of Petri dishes which have been inoculated with bacteria and incubated, the following extremely simple and rapid method may prove useful.

The special value of this method from the pedagogical point of view is its simplicity, no camera, plates, or dark room being necessary. This makes it possible for all members of a class to preserve accurate and permanent records in comparing bacterial counts in samples of water or milk, to show form of growth on Petri dishes, to illustrate the

colonies arising from the tracks of flies walking across the gelatine, etc.

The method consists of placing the uncovered Petri dish against photographic paper in a dark corner of the laboratory, bringing forward into the light, and returning to a dark corner for development and fixing. I have had very good results by using Azo hard X exposed to a medium light for five seconds. Good results can also be obtained by using blue-print paper exposed to bright sunlight for forty-five seconds. This paper requires less care in handling in the light and only water for fixing but must be fastened to the Petri dish by spring clip or gummed label to prevent moving during the long exposure.

The result of this direct photography is a positive; that is the white bacterial colonies on the Petri dish appear white on the print; not black as they would on a negative. Careful comparison of the direct prints with ordinary photographs made from a negative shows no loss by the shorter method.

A. A. COPE

SHELL-SHOCK IN THE BATTLE OF MARATHON

TO THE EDITOR OF SCIENCE: Herodotus, describing the battle of Marathon, 490 B.C. (Book VI., section 117), says:

The following prodigy occurred there: an Athenian, Epizelus, son of Cuphagoras, while fighting in the medley, and behaving valiantly, was deprived of sight, though wounded in no part of his body, nor struck from a distance; and he continued to be blind from that time for the remainder of his life. I have heard that he used to give the following account of his loss. He thought that a large heavy-armed man stood before him, whose beard shaded the whole of his shield; that this specter passed by him, and killed the man that stood by his side. Such is the account I have been informed Epizelus used to give.

Is this, perchance, the first account of "shell-shock"?

DEAN A. WORCESTER

THE AURORA OF AUGUST 11 AT BURLINGTON, VERMONT

ON August 11, at approximately 10 P.M. (E'n "Summer" Time), the aurora borealis, as seen in Burlington, Vt., appeared as follows:

On a cloudless night with a nearly full moon, and east-west band of light, from horizon to horizon, increased in brightness as each end broadened northward. The zenith became brilliant violet, an inverted bowl of shifting color. Practically the whole sky was bright; and especially just above the northern horizon intensely white rays shot up toward the zenith. Near the violet center, pale pink and green occasionally showed. The lights lasted for several minutes, lingering longest near the northern skyline.

JEAN DICKINSON

WILL THERE BE ANOTHER AURORA ABOUT SEPTEMBER 7-8, 1919?

THE intensity of the magnetic storm and the brilliance of the aurora of August 11-12 would indicate a disturbed region on the sun, the next presentation of which, opposite the earth about September 7-8, may produce another aurora. Such was the case April 4-6, 1918, following the brilliant aurora of March 7-8.

CHARLES F. BROOKS

QUOTATIONS

LABOR AND SCIENCE

ARE the great industrial countries moving in a vicious circle? The manifesto of the American Federation of Labor, which we publish [reprinted from SCIENCE] in another column, takes this view, and moreover, suggests a remedy. There is an "ever-increasing struggle of the workers to raise the standard of their living." Hitherto this has implied increased wages and shorter hours, or less production at higher cost. But now the "limit has been reached after which the average standard of living can not progress by the usual means of adjustment," by which are meant strikes, politicians' promises and public subsidies. If bankruptcy, moral and financial, is not to ensue, production, says the manifesto, must be increased by research and by the utilization in industry of the results of research. The vital necessity of scientific methods is clearly and cogently stated. In an age of steel and telegraphy, of aseptic surgery and of preventive medicine, of Mendelian breeding

and of tanks and poison gas, science is accepted as a paying proposition; but it is still too often looked on as a consultant to be called in special cases, or as a piecework artisan to be paid by the job. The manifesto proclaims a wider and a truer view. It distinguishes between "scientific" and "technical" research—that is to say, between disinterested and utilitarian explorations of nature. The former are demanded by those who know history; the latter mesmerize the bureaucracy. Labor demands a program of research in both senses; it declares the value of the advancement of knowledge to be many times greater than its cost; and it insists that many urgent problems can find wise solution only through scientific and technical research.—*London Times*.

SCIENTIFIC BOOKS

The Schrammen Collection of Cretaceous Silicispongiae in the American Museum of Natural History. By MARJORIE O'CONNELL, Ph.D. *Bulletin of the American Museum of Natural History*, Vol. XLI., Art. I., pp. 1-261, Plates I-XIV., Map and five text figures. Aug. 1, 1919.

In 1914 the American Museum purchased a collection of 800 specimens of fossil Silicispongiae, comprising 116 genera and 222 species, and purporting to be types (Belegestücke) used by Dr. Anton Schrammen of Hildesheim in the preparation of his important monograph on the Cretaceous Silicispongiae of northwest Germany. This material was entrusted to Dr. O'Connell for arrangement in the exhibition hall of the museum, in the course of which work she undertook a careful comparison of each specimen with the descriptions and illustrations in Schrammen's monograph. This led to the discovery that the term "Belegestück" was used in a very loose sense for material representing not only the true types, but also all material collected from type localities, and so included supplementary types (apotypes) as well as typical specimens (icotypes), the total of 358 types including only 86 primary types (with only 5 holotypes). This led Dr.

O'Connell to a careful evaluation of the standing of each one of these specimens, which proceeding has greatly enhanced the value of the collection. But beyond this, Dr. O'Connell has gone most thoroughly into the synonymies of the genera and species, Schrammen's work in this respect being misleadingly incomplete, and so she has produced a distinct contribution to the literature of the Silicispongiae, and supplemented Schrammen's monograph in a manner for which students of these organisms owe her thanks. This constitutes the major part of the work before us, being Chapter IV., and comprising pp. 97-207 of the *Bulletin*.

The first 97 pages of the bulletin however, are of broader scope, and will be of general interest, not only to students of paleontology but to those of stratigraphy as well. The introduction deals with the classification of the sponges and makes the latest classification by Broili (Zittel Grundzüge, 1915), and Schrammen available to American students. Chapter I. (pp. 8-30) gives a review of the development of the science of spongiology, dealing first with the investigations on recent, and then with those on fossil species. The history of investigation on recent forms is divided into five periods: (1) From the days of Aristotle to the seventeenth century; (2) period of determination of systematic position (1600-1750); (3) period of anatomical discoveries and classification (1750-1825); (4) period of detailed microscopic studies (1825-1874), and (5) period of modern investigations (1875-present), which opens with the first paper published by F. E. Schulze. The history of palæospongiology is thus summarized by Dr. O'Connell:

In going through the literature on fossil sponges, one is struck with the close parallelism in the development of thought in the study of fossil and recent forms but one sees epitomized in the paleontological literature of two hundred years what is spread over two thousand years in zoological literature. The besetting difficulty for both groups of investigators was the determination of the best method of work, and, until this was discovered, all classifications were unsatisfactory and often artificial.

Classification on the basis of form has now given way to classification on the basis of the skeletal elements, a method adopted for recent sponges by Schulze in 1875, and for fossil forms by Zittel in 1876.

In this chapter Dr. O'Connell gives a review of the work done on fossil sponges to date in Great Britain, France, Russia, Bohemia and Germany. Based upon the summaries given by Rauff (*Palæontographica*, 1893-94) the author has brought the review up to date, and given us moreover a critical evaluation of all the important works which she has been able to examine personally, so that the student, especially the one not conversant with German, will find this the most satisfactory general historical summary in print. It is true that a few important papers have been overlooked, among them Siemiradski's monograph, "*Die Spongien der Polnischen Juraformation*" ("*Beiträge zur Palæontologie und Geologie Österreich-Ungarns und des Orients*," Bd. XXVI., pp. 163-211, 1913, and in the Polish language in the publications of the Scientific Society of Warsaw for the same year), in which 92 species including a number of new ones are described according to modern methods, and illustrated on six quarto pages, and Vinassa P. de Regny's "*Trias-Spongien aus dem Bakony*" ("*Resultate der wissenschaftlichen Erforschung des Balatonsees*," Bd. I., 1901) and "*Neue Schwämme, Tabulaten und Hydrozoen aus dem Bakony*" (*ibid.*, 1908), but as the author's work was primarily with the Cretaceous sponges, such an oversight is not to be wondered at.

Chapter II. deals with the morphological characters of the Silicispongiæ, and this chapter is of value because it gives to the student the only comprehensive account of the characters and classification of the skeletal elements to be found in the English language not excepting that of Hinde. It is a more systematic presentation, because arranged chiefly in tabular form, than the elaborate one given by Rauff, and on that account will be found more serviceable to the general student. It is also more complete than that of Rauff, because it includes a number of new

types introduced by Schrammen, and renders moreover into English a number of terms so far only used in German literature. This chapter is illustrated by 14 plates of outline drawings, selected from the illustrations given by Rauff and Schrammen. By an oversight these are all credited to Schrammen on page 34, though 48 out of the total of 71 are from Rauff, as correctly given in the description of plates. Plates I.-V. give an illustration for each type of spicule, while on Plates VI.-XIV. are given illustrations of the actual spicules of the species represented in the American Museum collection. The relationships of the many special types of spicules to, and their derivation from the three fundamental types the triod, tetraxon and the triaxon are also clearly set forth. In the discussion of the microscleres, reference should have been made to the important, though preliminary paper by P. Ortman, "*Die Mikroscleren der Kieselspongien in Schwammgesteinen der Senonen Kreide*" ("*Neues Jahrbuch für Mineralogie*," etc., 1912. Bd. II., pp. 127-149).

Chapter III. presents in 50 pages a summary of the stratigraphy of the Upper Cretaceous formations of Europe, and is in many respects the most valuable part of the work. Here the student will find what is probably the best general summary of this subject in the English language and the reviewer would recommend the perusal of this chapter to all students of European stratigraphy. It is not merely a summary of text-book literature, but is evidently based on a study of the original works, and reveals the author's grasp of the fundamental principles of stratigraphy. The study of the Cretaceous stratigraphy of Europe was undertaken by Miss O'Connell, as she tells us in the preface, as a part of the research work under the Sarah Berliner Research Fellowship for Women which she held for the year 1917-1918, and which was a study of the "*Habitat of the Silicispongiæ*." In this discussion of the stratigraphy the field is divided into eleven provinces, the disconnected character of which is primarily the result of post-Cretaceous erosion, which in many areas has removed the transitional facies of the

sediments, so that there is often a decided lithic and faunal distinction between the deposits of the several provinces.

In the British province the chalk shows a transgressive character from the southeast towards the northwest, and generally begins with a basal clastic series which rests upon the eroded surface of various older formations. This is followed by greensands and glauconitic chalk, which formations are thus lithic rather than stratigraphic units, being of Aptian age in southeast England, of Cenomanian age in southern Antrim, Ireland, and of Senonian age in northern Antrim. The age of the base of the pure chalk varies in like manner. From the detailed analysis of the sponge faunas of Great Britain, it appears that there was in general a corresponding shifting in the maxima in the same general direction, the siliceous sponges of the Cenomanian, Turonian and Emsherian, being confined to the southern and southeastern counties, while the Senonian sponge fauna is best represented in Norfolk and Yorkshire.

A similar transgressive character of the Cretaceous sea and corresponding overlap and change of facies of the sediments is seen in the deposits which underlie the Tertiaries of the Paris Basin, and which are structurally stratigraphically and faunally united with those of southeast England and belong to the sediments of the Boreal sea of Cretaceous time. Marine conditions in part of this region began however in Lower Cretaceous time. The deposits of southern France, together with those of the Alps, belong to the persistent Tethys sea, and here extensive marine limestones accumulated in Lower Cretaceous time as well. The Cretaceous deposits of northern Germany (indicated upon an excellent copy of Walther's map, which unfortunately is reproduced on too small a scale), and those of Bohemia, also illustrate the transgressive character of the Cretaceous sea, most extensive in the Cenomanian, and further show a striking general change in facies from prevailing sandy (Quadersandstein) on the east to calcareous character on the northwest, the calcareous facies beginning

as intercalations of thin-bedded limestones (Pläner) in the sandstone series. Local contributions of sands from the Harz uplands, etc., also modify the facies, but the main events of Cretaceous paleogeography of the northern European basin as indicated by the sediments were the progressive transgression of the sea towards the west and north and the simultaneous advance of the terrigenous sands from the Bohemian and Vienna regions over the calcareous deposits, the two types being in the relation of replacing overlap. This is the key to the distribution of the sponge fauna of the several districts.

The bibliography which is limited to Cretaceous Silicispongiæ and important stratigraphic papers contains 280 titles all of which except 24 were consulted by the author, surely a remarkable piece of industry when it is considered that many of these are monographic works, and that several European languages are represented.

A few typographical errors have crept in, those noted being as follows: p. 52, end first paragraph, the reference to the *following table* should be to the *preceding table*; p. 61, *Wealden anticline* is used instead of *Wealden anticlinal* as elsewhere, to indicate the compound character of this structure.

Altogether the work here reviewed is most creditable, alike to the author and to the geological-paleontological department of the museum, and while it does not pretend to be an original contribution either to spongiology or to European stratigraphy, it is distinctly one in its keen analysis of European literature, and in the synthesis of the important facts of European stratigraphy into a comprehensive and very readable unit and for this American students will be grateful to the author.

A. W. GRABAU

ORGANIZATION OF THE AMERICAN SECTION OF THE PROPOSED INTERNATIONAL GEO- PHYSICAL UNION

At the invitation of the Royal Society issued June 17, 1918, an Inter-Allied Conference on International Scientific Organizations

was held in London from October 9 to 11, 1918. A further conference was held in Paris from November 26 to 29, 1918, at which organization was advanced, and the designation "International Research Council" was adopted.

At the Paris conference resolutions were passed by this International Research Council in favor of the establishment of an International Geophysical Union, "for the purpose of initiating and promoting researches in geophysics." The fields in science to be comprised under this title were not completely specified and only two sections were proposed at that time, viz.:

(a) A section dealing with geodesy and allied branches of science, such as the study of tides and mathematical "cartography;"

(b) A section of meteorology, with which shall be associated terrestrial magnetism, seismology and vulcanology;

but it was intended that other sections should be provided for. In these resolutions it was provided that "National Committees"¹ shall be appointed under the authority of the principal academy of science in each country, or by its government.

Following this an informal meeting of the Division of Physical Sciences, and invited guests, was held in Washington, D. C., on February 27, 1919, in response to a call by Mr. George E. Hale, chairman of the National Research Council, at which the actions of the London and Paris conferences were reported and discussed, and the general subject and content of the field of geophysics was considered.

A committee, consisting of Messrs. R. S. Woodward, chairman, L. A. Bauer, Wm. Bowie, Whitman Cross, A. O. Leuschner and C. F. Marvin, was appointed to consider the organization of an American Section of the proposed International Geophysical Union. Under date of March 4, 1919, this committee submitted the following report:

¹ Following the precedent in astronomy, in the United States the "National Committee" has been designated the "American Section," of the proposed International Geophysical Union.

TO THE CHAIRMAN OF THE NATIONAL RESEARCH COUNCIL:

Your committee appointed to consider the question of a logical and practicable organization of the proposed American Section of the International Geophysical Union respectfully submits the following report:

The earth is at once the subject and the object of many sciences. Of these the most important are astronomy, geodesy, geology, meteorology, seismology, terrestrial magnetism, terrestrial electricity, tides and vulcanology.

While each of these sciences is more or less distinct in itself, they are closely related to one another, and progress in any one of them may be expected to depend to a great extent on the general progress attained in the others. Each of these sciences has its devotees and its experts, and the number of these in the aggregate is now very large. Hence in any scheme of effective organization it is essential to secure groupings of these various subdivisions of geophysics in order that the number of groups may not be too unwieldy in the transaction of business essential to such organizations. But it should be distinctly understood that in recommending a limited number of groups for purposes of administration it is not desired to discourage relations of closest reciprocity between the devotees to the various sciences included in the groups. On the contrary, it is the opinion of your committee that progress in the future is most likely to result from active cultivation of the borderlands that now serve to diminish, but only indefinitely, the several fields of geophysics.

It should be understood also that the groupings recommended are to be regarded as provisional and subject to such changes as future experience may suggest. It is recognized also that the groupings here recommended may not be the most appropriate for all countries or possibly for an international organization, since much regard should be given in all such matters to historical precedents and to the circumstances presented at any epoch by individual investigators, and especially by governmental organizations, of any country.

With these reservations the committee recommends that the following groups of subjects should be recognized in the organization of the American Section of the International Geophysical Union:

Group 1: Geodesy. This group may be assumed to deal with questions concerning the size, the shape and the mechanical properties of the earth.

Group 2: Seismology and Vulcanology.

Group 3: Meteorology and Mareology, including especially all questions presented by the mechanical properties of the atmosphere and the oceans.

Group 4: Terrestrial Magnetism and Terrestrial Electricity. This group is intended to deal with the magnetic and the electric properties of the earth, including its atmosphere.

The committee recommends that initially the designation of members to constitute the proposed Geophysical Section be made by the National Academy of Sciences. It is further recommended that in making such designations regard be had to the desirability of securing representatives from the following government bureaus:

Bureau of Fisheries,
Bureau of Mines,
Bureau of Standards,
Coast and Geodetic Survey,
Hydrographic Office, U. S. N.
Geological Survey,
Weather Bureau.

Similarly, the committee suggests that representatives also may be fitly chosen from the following national societies:

American Astronomical Society,
American Mathematical Society,
American Physical Society,
Geological Society of America,
Seismological Society of America.

The committee further recommends that in order to promote research and discovery in geophysical science in general steps be taken by the American Section of the International Geophysical Union toward the formation of a new society to be called the American Geophysical Society.

Signed: R. S. WOODWARD,
for the Committee

This report was referred to the Division of Physical Sciences of the National Research Council, and was considered by this division at a special meeting held on March 10, 1919, called, in part, "to consider the organization of a Geophysical Section of the division to represent the division on the proposed International Geophysical Union." After discussion the Division of Physical Sciences voted to recommend to the Council of the Academy and to the Executive Board of the National Research Council.

1. The approval of the organization of a Section on Geophysics, to include the following groups of subjects:

Geodesy,
Seismology and Vulcanology,
Meteorology and Aerology,
Earth and Ocean Tides and Mareology,
Terrestrial Magnetism,

with the provision that the exact designation of subjects to be included and their grouping be determined by the section after its organization, in harmony with the general plans of the International Geophysical Union.

2. That the question of the formation of a geophysical society be referred to the Geophysical Section after its formation;

3. That the initial membership of the Section on Geophysics be constituted as follows:

Messrs. J. F. Hayford, R. S. Woodward, William Bowie, Joseph Barrell, Frank Schlesinger, A. O. Leuschner, E. W. Brown.

Messrs. H. F. Reid, J. C. Branner, H. O. Wood, A. L. Day, R. A. Daly, R. B. Sosman, Whitman Cross.

Messrs. A. G. McAdie, C. F. Marvin, W. J. Humphreys, E. H. Bowie, W. R. Blair, Max Mason, R. A. Millikan.

Messrs. G. W. Littlehales, J. T. Watkins, A. A. Michelson, F. R. Moulton, G. F. MacEwen, H. B. Bigelow.

Messrs. L. A. Bauer, S. T. Barnett, R. L. Faris, W. F. G. Swann.

On April 15, 1919, upon recommendation of Mr. A. O. Leuschner, acting chairman of the Division of Physical Sciences, the executive board of the National Research Council made the following appointments:

1. *Acting Chairman of the American Section of the proposed International Geophysical Union*, Mr. William Bowie.

2. *A committee to prepare recommendations regarding international cooperation in geophysical subjects for consideration by the American Section of the proposed International Geophysical Union*, Messrs. R. S. Woodward, *chairman*, L. A. Bauer, William Bowie, Whitman Cross, A. O. Leuschner, C. F. Marvin and H. F. Reid, with power to increase its membership.

At its first meeting, on May 20, 1919, this committee assumed the title, Provisional Executive Committee, and added Mr. H. O. Wood to its membership as its secretary.

3. *A Committee on Variation of Latitude of the American Section of the proposed International Geophysical Union to confer with a similar com-*

mittee of the American Section of the proposed International Astronomical Union to make joint recommendations with this Committee in regard to the future organization of researches on the variation of latitude, Messrs. William Bowie, chairman, F. R. Moulton and C. F. Marvin.

The executive board also determined that the organization meeting of the American section of the proposed International Geophysical Union should be held in Washington, in conjunction with the June, 1919, meeting of the American Section of the proposed International Astronomical Union, and that pending that meeting further organization of the American Section of the proposed International Geophysical Union should be left with its acting chairman with power.

At the meeting of the Interim Committee of the Executive Board of the National Research Council, on May 20, Mr. H. O. Wood was appointed acting secretary of the American Section of the proposed International Geophysical Union.

In preparation for the organization meeting and for the meetings in Brussels in July, 1919, of the International Research Council and the International Geophysical Union, four meetings of the Provisional Executive Committee were held, on May 20, June 3, June 10 and June 17. The organization meeting was held in three sessions, on June 24 and 25, 1919, at the building of the National Research Council, in Washington, D. C.

A digest of the action taken at these meetings is given below:

At the first meeting of the Provisional Executive Committee on May 29 the following gentlemen were designated as committees of one to prepare brief statements for the use of the delegates to the meetings at Brussels in regard to the past history, present status, and scientific purposes of each of the following international scientific bodies:

1. International Geodetic Association, Mr. Wm. Bowie.
2. International Seismological Association, Mr. H. F. Reid.
3. (a) International Meteorological Committee and (b) International Committee for the Study of the Free Atmosphere, Mr. C. F. Marvin.

4. International Commission of Terrestrial Magnetism, Mr. W. J. Peters.

Also Mr. R. S. Woodward, as chairman of the committee, was requested to prepare a brief statement for the use of the delegates in regard to the past history, present status, and scientific purposes of geophysics as a distinctive field in science.

As a result of discussion with respect to the appropriate place of vulcanology in the organic scheme Mr. Whitman Cross was requested to prepare a statement in regard to vulcanology similar, so far as possible, to those regarding the other subdivisions of geophysical science in their international aspects.

Two printed pamphlets issued by the Royal Society, entitled "Proposals for the Convention for an International Union of Geophysics—Approved by the Royal Society" and "International Geophysical Union," were read and discussed, and Mr. Leuschner was requested to prepare a clarifying statement in regard to foreign proposals for organization.

A committee consisting of the acting chairman of the American Section and the Chairman of the Provisional Executive Committee was appointed to consider the appointment of delegates to the Brussels meeting.

A Committee on Publications was appointed, consisting of the acting chairman and the acting secretary of the American Section, and Messrs. F. E. Fowle and G. S. Fulcher.

At the second meeting of the Provisional Executive Committee, on June 3, considerable time was devoted to the consideration of a project for geophysical investigations in the Arctic regions in cooperation with Roald Amundsen's expedition, under the auspices of the Norwegian government, which had been brought to the attention of the National Research Council by the Director of Naval Intelligence. Recommendations with respect to feasible action were made by the committee which were transmitted by the acting chairman of the section to the council.

Mr. Leuschner read a clarifying statement in regard to foreign proposals for organization which he had been requested to prepare. The substance of this, omitting illustrative

information given at length, is summed up in the following paragraph.

A large number of formal and informal international scientific organizations existed previous to the war. As a result of it these have lapsed, effectively, and in some cases the terms have expired during the course of the conflict. Because of the war the International Association of Academies has become defunct practically. A strong effort is being made to reconstitute the latter in the "International Research Council," and at the same time, to reconstitute, centralize, simplify in organization and minimize in number the previously very numerous international scientific organizations as "International Unions" affiliated with the International Research Council.

Attention was given to a "Proposed International Hydrographic Conference to be held in London in June, 1919," and action was recommended intended to secure a suitable correlation of this with the interests of the Mareological subsection as represented at Brussels.

A report was read by Mr. Bowie, for the Committee on Variation of Latitude which met jointly with the committee of the same title of the American Section of the proposed International Astronomical Union; and the report was approved for transmittal to the section.

A report was read by Mr. Wood, for the Committee on Publications, which was approved for transmittal to the section.

At the third meeting of the Provisional Executive Committee, on June 10, in connection with consideration of delegates to the meetings in Brussels, action was recommended to the chairman of the National Research Council toward the appointment of men already delegated to attend the Hydrographic Conference in London.

A Committee on the Investigation of Earth Tides, consisting of Messrs. A. A. Michelson, chairman, T. C. Chamberlin and F. R. Moulton, was appointed in response to a communication from Mr. Moulton recommending action on this subject.

A request from the Division of Geology and

Geography to the Division of Physical Sciences that a member of the latter division be appointed to represent the division on a committee of the Division of Geology and Geography to consider a specific project in seismology, was referred to this committee and the acting chairman of the American Section was requested to recommend to the Division of Physical Sciences a member of the division to be appointed to serve with the committee of the Division of Geology and Geography.

After brief comments on the subject Mr. Bowie was requested to prepare a statement in regard to isostasy for the June meeting.

At the fourth meeting of the Provisional Executive Committee, on June 17, further consideration was given to the matter of the delegates to the Brussels meeting and of the instructions or advice which should be given them.

After discussion it was the sense of the committee that the delegates to Brussels should have power to confer for the purpose of arriving at definite understandings in regard to the future status of international organization in science.

But, in order to provoke discussion and the free exchange of ideas in regard to this it was decided to transmit to the section the following recommendations:

That the International Research Council take such steps as are required to perpetuate the work of international organizations in science, if necessary by terminating previously existing arrangements, whether informal or dependent upon treaties or conventions; and

That the International Research Council recommend to the appropriate international unions the appointment of suitable committees on special subjects where continuation is desirable or necessary to provide plans for resumption and continuation of organization.

The opinion was stated that definite action to terminate previous international arrangements would probably be necessary in most cases.

The plan of the Royal Society in regard to financing the administration of the International Geophysical Union was discussed in

connection with a general consideration of this problem and certain specific details.

It was the sense of the committee that geochemical investigation should have appropriate representation in the American Section of the proposed International Geophysical Union.

It was recommended to postpone the question of the formation of an American Geophysical Society until after the Brussels meeting.

HARRY O. WOOD,
Acting Secretary

(To be concluded)

SPECIAL ARTICLES

BACTERIUM SOLANACEARUM IN BEANS

IN June, 1919, some badly diseased bush beans were received from Lynn Haven, Florida. The leaves were wilted and more or less brown. Often the petioles also were brown and wilted to their base. The roots were brown and the epidermis somewhat decayed in places. The woody parts of the plants, both stems and roots, had dark stained vascular bundles. Cross sections examined microscopically showed from 50 to 100 per cent. of the vessels to be full of bacteria and no fungi were visible. As the discoloration of the leaves was generally uniform, with no lesions apparent while the roots showed lesions and contained bacteria in great numbers the supposition was that the disease must be due to the bacteria and that they must have entered through the root system. The loss in the Florida field was about 20 per cent. of the beans planted.

Agar-poured plates gave pure cultures of a white bacterial organism having all the characteristics of *Bacterium solanacearum*.

Cultural work in other media and needle-prick inoculations made with sub-cultures of colonies taken from the poured plates confirmed this diagnosis.

A number of different legumes were inoculated by pricking the bacteria into the stems. Of beans, Waxbush, Red Valentine and Refugee proved very susceptible. These plants began to wilt two days after inocula-

tion and a number were entirely wilted and fallen over in seven days. In addition to those already mentioned, good infections were secured in: Lima beans (Fordhood variety), Pinto beans (a brown speckled variety) and Great Northern (a white Navy bean).

Inoculated in peas this parasite acts more slowly than in beans, but is not without pathogenic properties at least on some varieties. Following stem inoculation by needle pricks there is a slow drying and shriveling of the leaves but not a sudden wilt. The plants become stunted. Cross sections of the stems show bundles discolored and containing bacteria though in less abundance than in infected beans, tobaccos, or tomatoes. Telephone, Little Marvel and Mammoth Luscious Sugar were the varieties of peas that became infected. The organism has been reisolated from both beans and peas, and proved to have the same characters and infectiousness (tested on tobacco and beans), as the original culture.

The organism was also found to be infectious to soy beans (variety Ito San) and to cowpeas (variety Black Cow).

Tobacco and tomato plants used for control showed typical *Bacterium solanacearum* infections.

So far as known this is the first time this disease has been observed in beans, peas, soy beans or cowpeas, although known to occur in peanuts, in *Mucuna* sp., and in some other legumes. Fortunately beans appear to be very susceptible only in early stages of growth.

ERWIN F. SMITH,
LUCIA McCULLOCH

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